REMARKS

Favorable reconsideration of this application is respectfully requested.

Claims 23-31 are pending in this application. The present amendment amends Claims 23, 29 and 31 without introducing any new matter.

In the outstanding Office Action, Claim 31 is objected to because of informalities. Claims 23-24 and 29 are rejected under 35 U.S.C. § 102(b) as anticipated by Malhi (U.S. Patent No. 5,349,207). Claims 23-24 and 29 are rejected under 35 U.S.C. §102(e) as anticipated by Merchant et al. (U.S. Patent N. 6,118,181, herein "Merchant"). Claims 25 and 30-31 are rejected under 35 U.S.C. § 103(a) as unpatentable over Merchant in view of Goesele et al. (U.S. Patent No. 5,877,070, herein "Goesele"), and Linn et al. (U.S. Patent No. 5,387,555, herein "Linn"). Claims 26-28 are rejected under 35 U.S.C. §103(a) as unpatentable over Merchant in view of Doyle et al. (U.S. Patent No. 6,423,614, herein "Doyle").

In response to the objection to Claim 31, Claim 31 is amended to recite "forming at least one thin oxide layer onto at least one of the deposited layers with a thickness of a few angstroms; applying the two faces one against the other, with interposing of the layers of deposited material and the at least one thin oxide layer; and carrying out a heat treatment for combining the deposited layers to form one layer that provides an electrically conducting bonding between the two faces, wherein the at least one thin oxide layer is interposed between the two faces." This change finds non-limiting support in Applicants' disclosure as originally filed, for example in original Claim 4, and at page 10, lines 23-33. In view of amended Claim 31, it is believed that all pending claims are definite and no further rejection on that basis is anticipated. If, however, the Examiner disagrees, the Examiner is invited to telephone the undersigned who will be happy to work with the Examiner in a joint effort to derive mutually acceptable language.

To clarify Applicants' invention, independent Claims 23, 29 and 31 are amended to recite "metallic material," instead of "electric conductor material." In addition, independent Claim 31 is amended to recite "layer" instead of "conductive layer," for consistency. These changes also find non-limiting support in Applicants' disclosure, for example from page 7, line 27, to page 8, line 10.

In light of the amendments to the independent claims, Applicants respectfully request reconsideration of the rejection of Claims 23-24 and 29 under 35 U.S.C. §102(b) over Malhi, and traverse the rejection, as next discussed.

Briefly summarizing, Applicants' Claim 23 relates to a method of creating an electrically conducting bonding between a face of a first semiconductor element and a face of a semiconductor film included in a second semiconductor element by heat treatment. The method includes, *inter alia*, the steps of: depositing at least one layer directly on the face of the first semiconductor element, depositing at least one layer directly on the face of the semiconductor film, ***wherein at least one of the layers*** deposited on the first semiconductor element and on the semiconductor film ***is a metallic material***; carrying out a heat treatment for combining the deposited layers to form one layer that provides an electrically conducting bonding between the two faces, wherein the at least one layer deposited onto the face of the first semiconductor element and the at least one layer deposited onto the face of the semiconductor film are chosen to react in a solid phase during the heat treatment and to ***form a temperature stable mixture with respect to the first and the second semiconductor elements***.

As explained in Applicants' specification, Applicants of the present invention recognized that certain bonding solutions result in the consumption of a part of a

semiconductor film, which may be disadvantageous in the case of very thin films, and also result in the diffusion of a metal into a semiconductor, which can degrade its properties.[1]

Turning now to the applied references, Malhi describes a method to bond together a silicon wafer 20 with a silicon carbide (SiC) wafer 30, wherein the bonding layer 58 may comprise silicon germanium, silicon dioxide, or silicate glass.[2] Accordingly, Malhi fails to teach or suggest that at least one of the layers deposited on the first semiconductor element and on the semiconductor film is a metallic material, as recited in Applicants' independent Claims 23 and 29.

In addition, Malhi further explains that SiGe layers 54 and 56 are temperature-treated above the melting point of SiGe, being between 950°C and 1400°C, and that the layers 54 and 56 melt to form a bond layer 58.[3] However, Applicants' independent Claims 23 and 29 clearly recite:

> wherein the at least one layer deposited onto the face of the first semiconductor element and the at least one layer deposited onto the face of the semiconductor film are chosen ***to react in a solid phase*** during the heat treatment and to ***form a temperature stable mixture*** with respect to the first and the second semiconductor elements.

Accordingly, melting two layers to form a bond layer, as described by Malhi, ***is not*** carrying out a heat treatment for combining the deposited layers, to react in a solid phase to form a temperature stable mixture. Therefore, Malhi fails to teach or suggest all the elements of Applicants' amended, independent Claims 23 and 29, and accordingly, Applicants respectfully request reconsideration of the rejection.

Regarding the rejection of Claims 23-24 and 29 under 35 U.S.C. §102(e) over Merchant, Applicants respectfully request reconsideration of the rejection, as next discussed.

The reference Merchant describes the bonding of two wafers, wherein a palladium (Pd) layer on the first wafer is engaged with silicon (Si) layer from the second wafer, by

[1] See, for example, in Applicants' specification at page 2, lines 20-26.
[2] See Malhi in the Abstract.
[3] See Malhi at column 4, lines 21-29.

annealing.[4] Merchant further explains that to bond the silicon layer 31 with the palladium layer 27, a annealing step below 450°C is used, to thereby create an electrically conducting bond between the two layers.[5] However, Merchant fails to teach or suggest

> carrying out a heat treatment for ***combining the deposited layers to form one layer*** that provides an electrically conducting bonding between the two faces ... wherein the at least one layer deposited onto the face of the first semiconductor element and the at least one layer deposited onto the face of the semiconductor film ***are chosen to react in a solid phase during the heat treatment and to form a temperature stable mixture*** with respect to the first and the second semiconductor elements,

as recited in Applicants' independent Claims 23 and 29. The annealing temperatures used in Merchant to create a bond between two layers, is not sufficient to carry "out a heat treatment for combining the deposited layers to form one layer," as recited in Applicants' independent Claims 23 and 29. As further detailed in Merchant, "a bond 33 is formed between wafers 21 and 23 without melting the palladium layer 27 and the silicon layer 31."[6]

Therefore, both references Malhi and Merchant fail to teach or suggest all the features of Applicants' independent Claims 23 and 29. Even if the combination of Malhi and Merchant is assumed to be proper, the combination fails to teach every element of the claimed invention. Specifically, the combination fails to teach the claimed reacting in a solid phase during the heat treatment and to form a temperature stable mixture. Accordingly, Applicants respectfully traverse, and request reconsideration of this rejection based on these references.[7]

In response to the rejection of Claims 25 and 30-31 under 35 U.S.C. §103(a) over Merchant, Goesele and Linn, Applicants respectfully traverse the rejection and requests reconsideration of the rejection, as next discussed.

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[4] See Merchant in the Abstract.
[5] See Merchant at column 4, lines 8-19.
[6] See Merchant at column 6, lines 33-36.
[7] See MPEP 2142 stating, as one of the three "basic criteria [that] must be met" in order to establish a *prima facie* case of obviousness, that "the prior art reference (or references when combined) must teach or suggest all the claim limitations," (emphasis added). See also MPEP 2143.03: "All words in a claim must be considered in judging the patentability of that claim against the prior art."

While Merchant describes the bonding of two wafers, Merchant fails to teach or suggest the forming at least one thin oxide layer onto at least one of the deposited layers with a thickness of a few angstroms, as recited in Applicants' independent Claim 31, as further confirmed by the outstanding Office Action.[8]

The outstanding Office Action rejects Applicants' independent Claim 31 based on the proposition that Linn discloses the above feature,[9] and that it would have been obvious to modify Merchant by importing this feature from Linn to arrive at the Claim 31 feature. Applicants respectfully submit, however, that Linn fails to disclose the above feature related to a thin oxide layer deposited onto at least one of the deposited layers with a thickness of a few angstroms, as next discussed.

The outstanding Office Action relies on Linn's passage from column 6, line 58, to column 7, line 28, and in corresponding Figures 5a-b. This passage of Linn describes thermal oxide layers 406 and 506, and recites "has a 500 Å thick thermal oxide layer." In Linn, the oxide layers 406 and 506 are the thinnest insulating layer separating the second semiconductor element 502 from the electrical bonding, and this oxide layer 506 has a thickness of 0.05 μm.[10] Thereby, the oxide layer 506 in Linn ***does not*** have a thickness of a few angstroms, and in fact is not even thin enough for forming, after reaction, "isolated precipitates that do not substantially harm the electrically conducting bonding," as further recited in independent Claim 31.

Regarding the reference Goesele, these teachings were not cited with respect to the above-noted features regarding the thin oxide layer, and are not believed to overcome the above-noted deficiencies in Linn.

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[8] See the outstanding Office Action, at page 6, lines 9-12, and from page 6, last line to page 7, line 1.
[9] See outstanding Office Action at page 7, lines 1-7.
[10] See Linn at column 6, lines 40-49.

Therefore, even if any combination of Merchant, Linn and/or Goesele is assumed to be proper, the combination fails to teach every element of the claimed invention. Specifically, the combination fails to teach the claimed thin oxide layer. Accordingly, Applicants respectfully traverse, and request reconsideration of, this rejection based on these references.[11]

Applicants also respectfully traverse the obviousness-type rejection based on Merchant and Linn because there is insufficient evidence for a motivation to modify Merchant's bonding of two layers with temperatures smaller than 450°C,[12] by incorporating Linn's silicidation and oxidation bonding at 900°C,[13] for the following reasons.[14]

It is not clear from the record how Linn's 500Å thick thermal oxide layer could be incorporated into the Merchant's bonding at low temperature. Under such a modification, the Merchant's bonding process would not be operable, since the 500Å thick thermal oxide layer would prevent electric conduction between Merchant's silicon layer 31 and palladium layer 27, since Merchant requires "electrical connection between any circuitry included within wafer 23 and any circuitry included within wafer 21."[15] In addition, Merchant also requires that "[t]he bonding wafer 23 may be of any suitable configuration as long as the bonding materials can be bonded at CMOS compatible temperatures." However, Linn's temperatures around 900°C are not CMOS compatible, and therefore Linn teaches away from Merchant.

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[11] See MPEP 2142 stating, as one of the three "basic criteria [that] must be met" in order to establish a *prima facie* case of obviousness, that "the prior art reference (or references when combined) must teach or suggest all the claim limitations," (emphasis added). See also MPEP 2143.03: "All words in a claim must be considered in judging the patentability of that claim against the prior art."

[12] See Merchant at column 4, lines 8-19.

[13] See Linn from column 6, lines 40, to column 7, line 48.

[14] See MPEP 2143.01 stating "[o]bviousness can only be established by combining or modifying the teaching of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art," (citations omitted). See also MPEP 2144.08 III stating that "[e]xplicit findings on motivation or suggestion to select the claimed invention should also be articulated in order to support a 35 U.S.C. 103 ground of rejection. . . Conclusory statements of similarity or motivation, without any articulated rational or evidentiary support, do not constitute sufficient factual findings."

[15] See Merchant in column 4, lines 17-19.

In this respect, "[a] reference may be said to teach away when a person of ordinary skill in the art, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." In re Gurley, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994).

Therefore, such proposed modification would require a substantial reconstruction or redesign of the steps of Merchant's method, and/or would change the basic principle of operation of Merchant. There is no evidence that a person of ordinary skill in the art would be motivated to perform such changes and redesign.[16]

Regarding the rejection of dependent Claims 26-28 under 35 U.S.C. §103(a) over Merchant and Doyle, since the rejections of independent Claim 23 is believed to be overcome, the rejection of dependent Claims 26-28 is also believed to be overcome. In addition, the reference Doyle, even if *in arguendo* combined with Merchant, fails to remedy the deficiencies of Merchant. Doyle describes a process of bonding between an oxide film 305 to bond to a metal film 312 with a anneal process around 400°C.[17] Accordingly, Doyle also fails to teach or suggest the carrying out of a heat treatment for combining the deposited layers to form one layer that provides an electrically conducting bonding between the two faces, as recited in independent Claim 23. Therefore, Applicants respectfully traverse the obviousness-type rejection of Claims 26-28, and requests reconsideration of the rejection.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for formal Allowance. A Notice of Allowance for Claims 23-31 is earnestly solicited.

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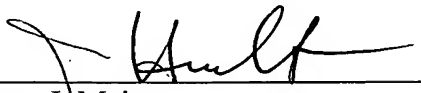
[16] See In re Ratti, 270 F.2d 810, 813, 123 USPQ 349, 352 (reversing an obviousness rejection where the "suggested combination of references would require a substantial reconstruction and redesign of the elements shown in [the primary reference] as well as a change in the basic principle under which the [primary reference] construction was designed to operate.")

[17] See Doyle at column 4, lines 3-21 and in corresponding Figure 7.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact Applicants' undersigned representative at the below listed telephone number.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



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